

The Application of 3D Additive Machining to Enhance the Affordability of a Small Launcher Booster Stage, Phase I

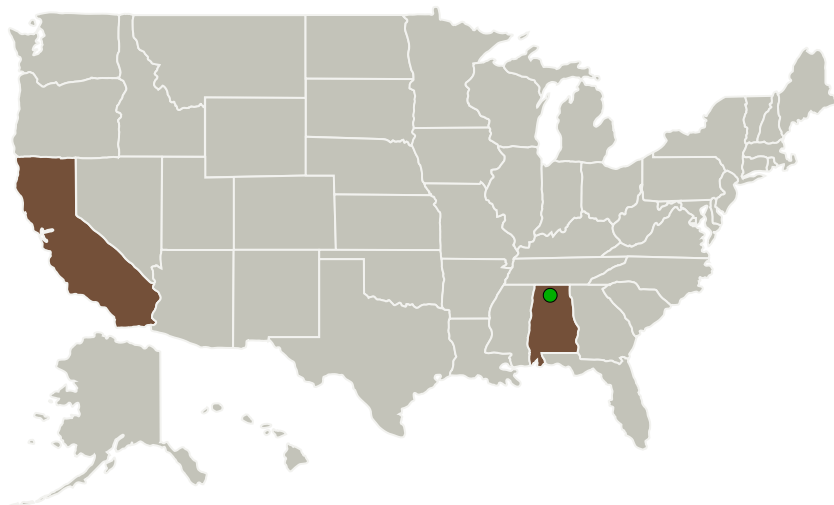
Completed Technology Project (2014 - 2014)



Project Introduction

The technical innovation proposed here expands upon early research into the viability of additive machining (AM) for liquid rocket engine components and other emerging capabilities to initiate TRL 6 flight test evaluations of candidate applications that could enhance the affordability of a small launch vehicle (SLV) booster stage. University of California, San Diego (UCSD) has achieved success in applying 3D AM to fabricate a 200 lbf-thrust LOX/kerosene engine. Concurrently, the Garvey Spacecraft Corporation (GSC) team continues to make progress in the development and flight testing of key elements for a future low-cost nanosat launch vehicle (NLV). These NASA-sponsored NLV designs, concept of operations (CONOPS) and cost metrics based on actual flight operations now serve as references for evaluating emerging technologies like UCSD's AM engine(s) to implement an SLV first stage that achieves the aggressive cost, performance and sizing goals specified in the T1.02 subtopic description. This is exactly the same approach that was followed under a previous NASA STTR that successfully demonstrated a TRL 6 for an advanced CMC-lined ablative engine chamber. Phase I flight testing features a subscale host vehicle, while Phase II then follows with an SLV-scale prototype booster.

Primary U.S. Work Locations and Key Partners



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Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

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Organizations Performing Work	Role	Type	Location
Garvey Spacecraft Corporation	Lead Organization	Industry	Long Beach, California
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
University of California-San Diego(UCSD)	Supporting Organization	Academia	La Jolla, California

Primary U.S. Work Locations

Alabama	California
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Project Transitions

▶ **June 2014:** Project Start

✓ **December 2014:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137327>)

Images



Briefing Chart

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(<https://techport.nasa.gov/image/130217>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Garvey Spacecraft Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

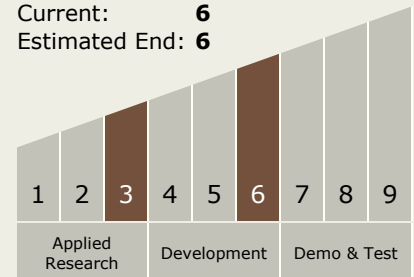
Carlos Torrez

Principal Investigator:

Christopher M Bostwick

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.4 Manufacturing
 - └ TX12.4.1 Manufacturing Processes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System